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# An Automated Hanging Mercury Drop Electrode

by

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This paper describes the construction of an automated static mercury drop electrode dispenser. It can be constructed from readily available materials, requires little maintenance, is easy to fill, and dispenses very reproducibly.

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# AN AUTOMATED HANGING MERCURY DROP ELECTRODE

by

W. Arthur Byers and S. P. Perone*

Automatic production of a constant area mercury drop has presented considerable problems in the past. Stepper motor driven electrodes of the microburet variety have been used with some success, but frequent filling of the electrode is required. Use of a slowly dropping mercury electrode to approximate a stationary drop eliminates the filling problem, but the very narrow capillary bore leads to frequent clogging and irreproducibility. In addition, long drop times needed for stripping and short drop times necessary to avoid adsorption effects are not possible.

Princeton Applied Research has recently marketed an instrument called the "static mercury drop electrode" which overcomes the previously mentioned disadvantages by valving the flow of mercury through a wide bore capillary (1, 2). The mercury is allowed to flow for a few hundred milliseconds until the drop has grown to the desired size. The drop growth is then terminated by a solenoid controlled polyurethane seal which plugs the mercury reservoir end of the capillary. Electrical connection is made by a tin oxide coating on the surface of the electrode.

This paper presents a static mercury drop electrode which can be constructed from materials readily available in most laboratories. The electrode requires little maintenance, is easy to fill, and dispenses very reproducibly.

The accompanying figure shows the basic construction of the electrode. In this design, a sharpened stainless steel wire is pulled in and out of a wide bore capillary by a 6 V solenoid to valve the mercury flow. The capillary is

.006 inches internal diameter and has been blown out at the end so that the wire is guided to the orifice. A microburet HMDE capillary can be used if the reservoir section is removed.

The wire is sharpened to a fine point which extends 1 mm into the capillary beyond where the capillary and the wire first make contact. A thin layer of electroplated gold improves the wetting of the wire by the mercury resulting in a good electrical connection.

The wire is sealed into a glass plunger with epoxy. The plunger is housed by a slightly larger glass tube which also contains the mercury. This larger tube is connected by Tygon tubing to the capillary. The connection is made rigid by yet another glass tube which fits over the Tygon tubing. This arrangement allows easy replacement of the capillary.

A 6 V continuous duty solenoid lifts the plunger a distance of 2 mm and can be activated by a computer controlled relay from 0.1 to 0.6 seconds to form various drop sizes. Drop mass varies linearly with solenoid activation time from 1 to 16 milligrams. The standard deviation of the drop mass is 0.1 milligram. After the necessary electrochemical measurements are made, a solenoid drop knocker strikes the electrode to dislodge the drop.

The electrode described here has been in use for 12 months. During that time the only maintenance required has been an occasional cleaning of the capillary tip. This can be done by activating the solenoid and applying a vacuum to the capillary tip. The rush of mercury through the capillary removes any clogs.

## References

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2. A. M. Bond, J. Electroanal. Chem., 118, 381 (1981).

Credit

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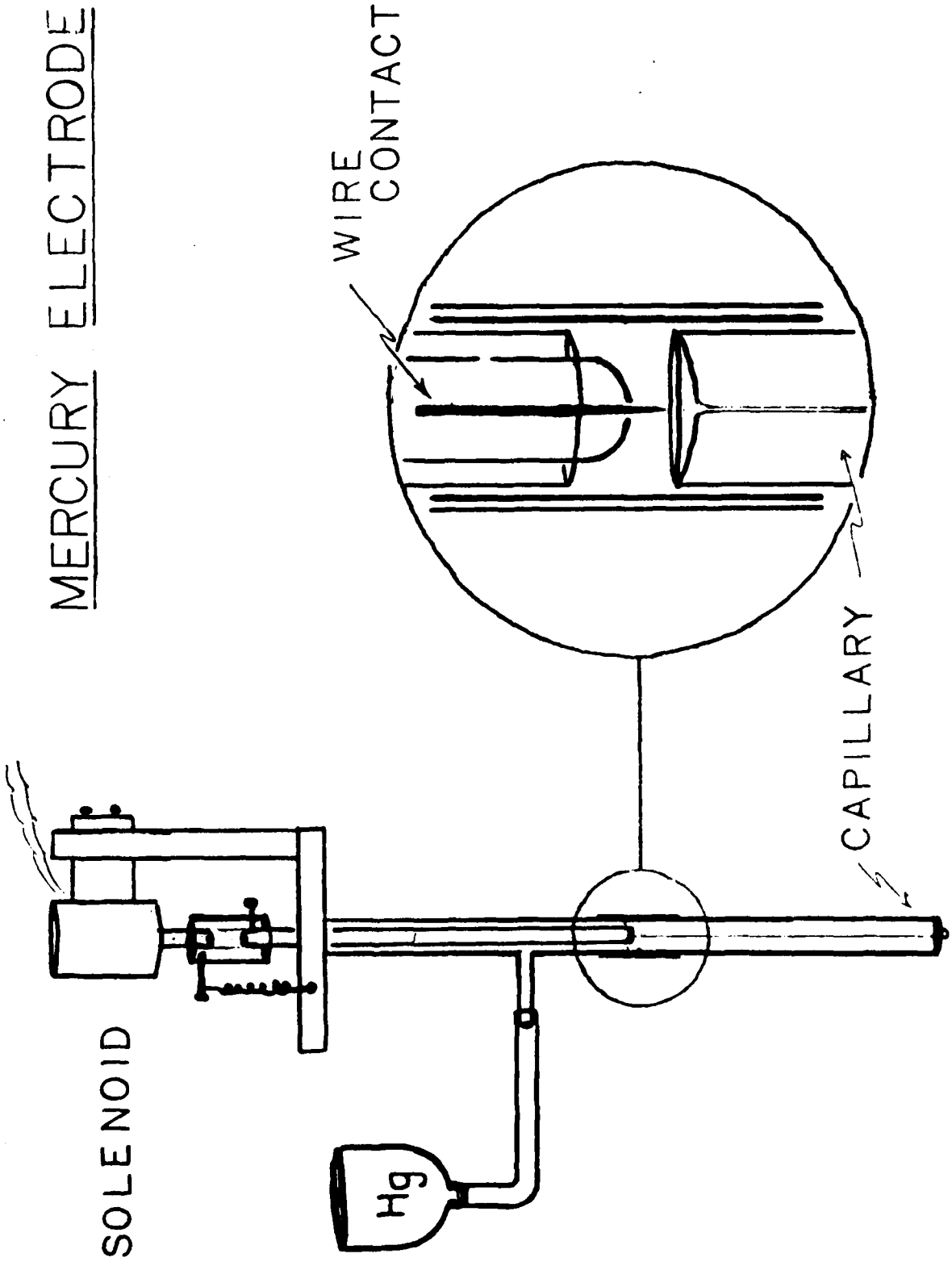
List of Figures

# MERCURY ELECTRODE



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